1. An apparatus for detecting wavelength errors, the apparatus comprising:

a photonic input path configured to carry a photonic input signal having a wavelength;

a modulation synthesizer configured to provide first and second modulation waveforms;

first and second modulation devices configured to modulate the photonic input signal with the first and second modulation waveforms, respectively, thereby providing first and second modulated photonic signals;

the first and second modulation waveforms configured to produce a wavelength offset between the first and second modulated photonic signals;

a filter apparatus configured to filter the first and second modulated photonic signals, thereby providing first and second filtered photonic signals; and

a differential detector configured to receive the first and second filtered photonic signals and provide a wavelength error signal proportional to the difference in intensity therebetween.

2. The apparatus of claim 1, further comprising:

first and second photonic output paths configured to carry the first and second modulated photonic signals, respectively; and

the filter apparatus further configured to direct the first and second modulated photonic signals substantially through the same physical region of the filter apparatus.

3. The apparatus of claim 1, wherein the differential detector is physically adjacent to the filter apparatus.

4. The apparatus of claim 1, wherein the filter apparatus comprises a Bragg filter.

5. The apparatus of claim 1, further comprising:

a shift input line configured to carry a shift signal; and

the first and second modulation waveforms further configured to shift the wavelengths of the first and second modulated photonic signals with respect to the wavelength of the photonic input signal, in proportion to the shift signal.

6. The apparatus of claim 5, wherein the shift signal is characterized by a spreading function.

7. The apparatus of claim 5, wherein the shift signal is characterized by a gathering function.

8. The apparatus of claim 5, wherein the shift signal is characterized by the difference of two spreading functions.

9. The apparatus of claim 5, further wherein the shift signal comprises an allowable range of wavelength shifts.

10. The apparatus of claim 1, wherein the first and second modulation devices comprise phase modulators.

11. The apparatus of claim 1, wherein the first and second modulation devices comprise quadrature amplitude modulators.

12. The apparatus of claim 11, wherein the quadrature amplitude modulators comprise an upper branch and a lower branch, each having a transfer function, the first and second modulation waveforms being quadrature waveforms comprised of upper and lower waveform components corresponding to the upper and lower branch, the upper and lower waveform components being substantially 90 degrees out of phase.

13. The apparatus of claim 12, wherein the upper and lower waveform components are substantially sinusoids divided by the transfer function of the upper and lower branches respectively.

14. The apparatus of claim 12, wherein the upper and lower waveform components are substantially sawtooth in shape.

15. The apparatus of claim 12, wherein the upper and lower waveform components are substantially triangular in shape.

16. The apparatus of claim 1, wherein the first and second modulation waveforms are substantially sawtooth in shape.

17. The apparatus of claim 1, wherein the first and second modulation waveforms are substantially triangular in shape.